THE GERMINATION LID: A CHARACTERISTIC OF THE LEMMA IN THE PANICEAE

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The presence of a hinged structure on the proximal surface of the lemma in *Setaria italica* (L.) Beauv. was first observed by Keys (1949). Rost (1975) further described this hinged structure in *S. lutescens* (Weigel) Hubb. and clearly demonstrated its role in germination. He also suggested its universal occurrence and possible taxonomic significance in the Panicoideae. The following study comprises an attempt to sample the Gramineae to determine the distribution and comparative structure of the germination lid.

MATERIALS AND METHODS

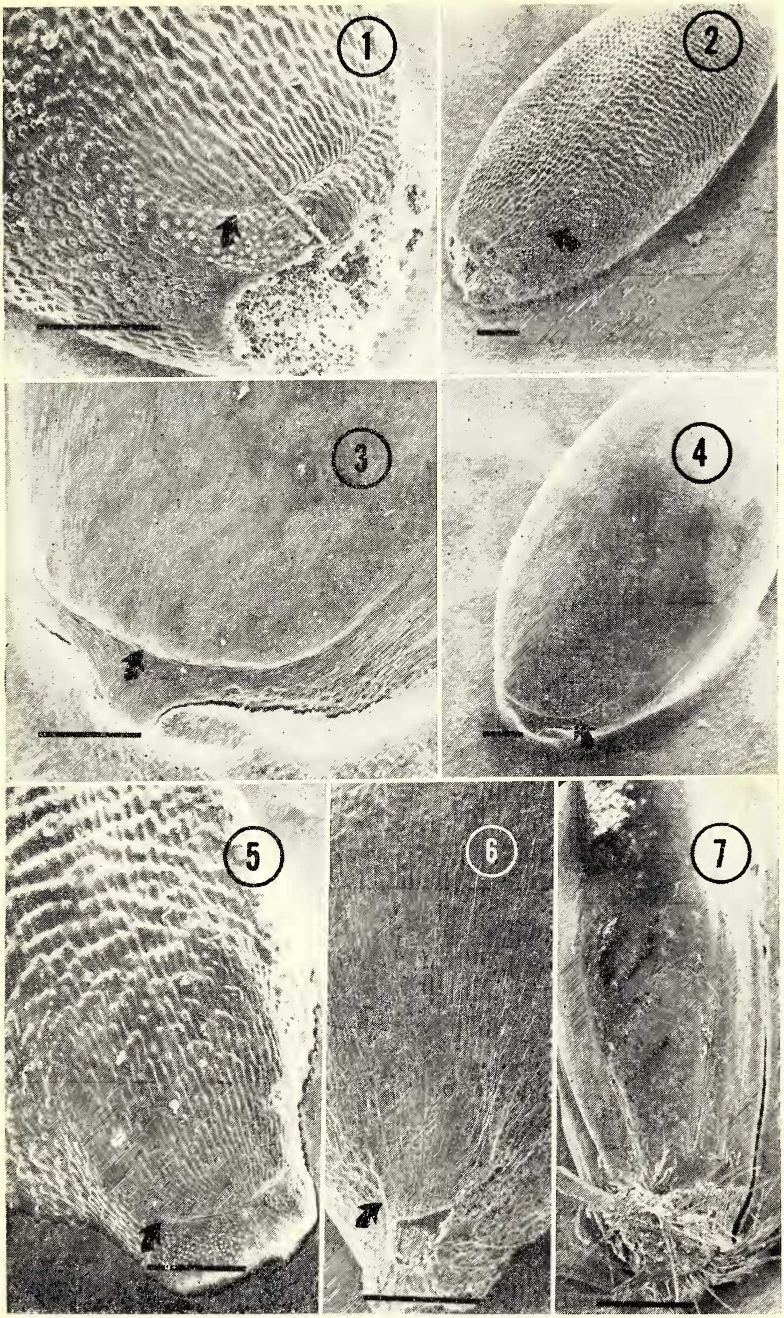
Florets were removed from herbarium sheets in AHUC and DAV. Other samples were supplied by Dr. Edward Terrell of the U.S.D.A. Plant Taxonomy Laboratory, Beltsville, Md. Crampton (1974), Hitchcock (1951) and Stebbins and Crampton (1961) were used as authorities on the Gramineae. Florets were soaked for 1 to 5 days in water to expand the embryos and make the germination lid, if present, more apparent. Measurements were made with an ocular micrometer mounted in an A/O stereo dissecting microscope. The scanning electron micrographs were taken of gold coated florets with a Cambridge Stereoscan S4.

RESULTS AND DISCUSSION

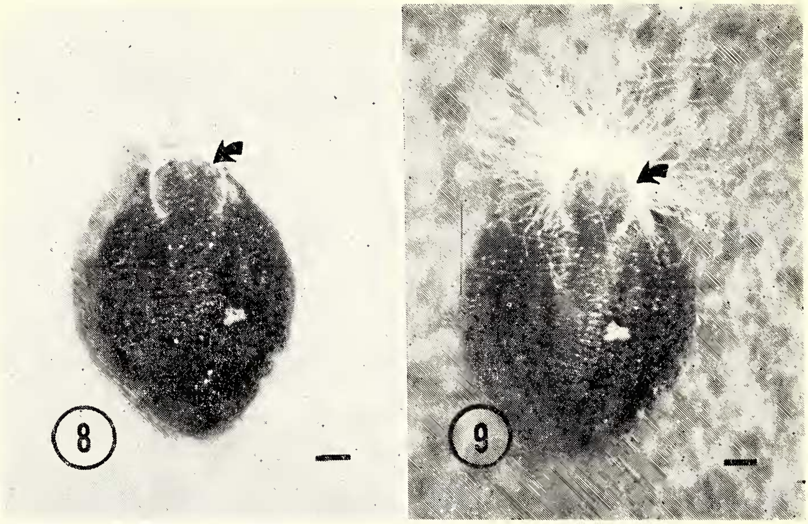
The taxonomic value of floret morphology has long been considered important in grasses. Reeder (1957; 1962) has shown the value of the grass embryo as a taxonomic character. For our study, 121 species were examined, representing 68 genera, 30 tribes, and 6 subfamilies.

The germination lid consists of a tiny hinged structure with a slightly indented outline located proximally on the surface of the lemma. The shape of the lid varies from a thin arc to a deep, almost square-shaped lid (figs. 1–6). During germination the coleorhiza forces open the lid, thereby facilitating easy passage through the usually hard, silicated lemma (figs. 8 and 9). The coleoptile emerges by forcing open the lemma and palea at the distal end of the floret, causing it to pivot open below and opposite the germination lid. Florets of Paniceae range from 10 mm to less than 1 mm in length. Germination lids range from 0.06–2.25 mm long × 0.17–0.75 mm wide. Most lids were approximately 0.25 mm square (Table 1).

Some contention exists as to whether certain genera (e.g., *Anthephora, Melinis,* and *Olyra*) belong in the Paniceae. Two members of *Anthephora* were examined: *A. pubescens* Ness. had a very papery lemma and showed



FIGS. 1–7. Scanning electron micrographs of grass florets. 1–6. Paniceae showing variation in germination lid shape. 1 and 2, *Eriochloa gracilis;* 3 and 4, *Panicum miliaceum;* 5, *Brachiaria ramosa;* 6, *Cenchrus palmeri*. 7, Floret surface morphology in *Andropogon ternarius* Michx. (Andropogoneae). All line scales equal 0.25 mm.



FIGS. 8 and 9. Germinating florets of *Setaria lutescens* showing opened germination lid with extended coleorhiza; line scales equal 0.25 mm.

TABLE 1. GERMINATION LID AND FLORET MEASUREMENTS FOR SELECTED MEMBERS OF PANICEAE. Size of lid varies with floret size and stage of development.

Species	Floret length (mm)	Lid length (mm)	Lid width (mm)
Amphicarphum purshii Kunth	2.60	0.37	0.50
Anthaenantia rufa (Ell.) Schult.	2.50	0.37	0.37
Anthephora hermaphrodita (L.) Kuntze	3.50	0.25	0.30
Axonopus affinis Chase	1.49	0.24	0.41
A. compressus (Swartz) Beauv.	1.82	0.24	0.33
Brachiaria ophyrodes Chase	2.62	0.37	0.50
B. praetervisa (Domin) Hubbard	2.50	0.50	0.50
B. ramosa (L.) Stapf	2.62	0.50	0.62
B. subquadripara (Trin.) Hitchc.	5.00	0.50	0.62
Cenchrus incertus M. A. Curtis	5.00	1.25	0.75
C. myosuroides H.B.K.	2.64	0.52	0.39
C. palmeri Vasey	6.25	2.25	0.75
C. pauciflorus Benth.	6.00	2.00	1.00
Digitaria ischaemum (Schreb.) Schreb. ex Muhl.	1.99	0.24	0.33
D. liniare Kratar	2.00	0.25	0.25
D. pentzii Stent	2.93	0.06	0.16
D. sanguinalis (L.) Scop.	2.75	0.37	0.37
Echinochloa colunum (L.) Link	1.08	0.26	0.49
E. crusgalli (L.) Beauv.	2.75	0.25	0.50
E. crus-pavonis (L.) Beauv.	2.76	0.23	0.66
E. frumentacea Link	3.00	0.50	0.62
E. haploclada Stapf	2.50	0.50	0.50
E. muricata (Michx.) Fernald	3.50	0.35	0.35

TABLE 1. *Continued*

Eriochloa contracta Hitchc.	2.51	0.43	0.43
E. gracilis (Fourn.) Hitchc.	2.64	0.39	0.59
E. lemmonii Vasey & Scribn.	2.50	0.25	0.50
E. montevidensis Griseb.	2.21	0.59	0.49
E. sericea (Scheele) Munro	2.75	0.62	0.62
Leptoloma cognatum (Schult.) Chase	2.25	0.19	0.16
Neurachne xerophila Domin	5.50	0.50	0.50
Olyra latifolia L.	5.50	1.00	1.00
Panicum agrostoides Spreng.	1.32	0.16	0.26
P. angustifolium Ell.	2.01	0.33	0.75
P. antidotale Retz.	1.68	0.26	0.56
P. capillare L.	2.50	0.50	0.62
P. condensum Nash	1.46	0.05	....
P. dichotomiflorum Michx.	2.07	0.22	0.50
P. hillmanii Chase	2.12	0.27	0.62
P. lassenianum Schmoll.	0.97	0.45	0.17
P. miliaceum L.	3.25	0.60	0.90
P. occidentale Scribn.	1.55	0.20	0.50
P. pacificum Hitchc. & Chase	1.40	0.25	0.92
P. scribnerianum Nash	3.37	0.50	0.87
P. thermale Boland.	1.61	0.26	0.41
Paspalum dilatatum Poir.	2.50	0.17	0.62
P. floridanum Michx.	4.25	0.50	1.50
P. notatum Flügge	2.87	0.25	0.75
P. quadrifarium Lam.	2.25	0.12	0.37
P. urvillei Steud.	2.37	0.16	0.79
Pennisetum typhoideum (L.) Rich.	3.75	0.50	0.50
P. villosum R. Br.	10.00	0.49	0.50
Setaria faberi Herrm.	2.08	0.49	0.50
S. geniculata (Lam.) Beauv.	1.90	0.50	0.50
S. lutescens (Weigel) Hubb.	3.25	0.50	0.50
S. macrostachya H.B.K.	2.20	0.37	0.50
S. magna Griseb.	1.83	0.33	0.49
S. reverchonii Pilger	2.89	0.37	0.50
S. scheelei (Steud.) Hitchc.	2.75	0.37	0.50
S. sphacelata (Schum.) Stapf & C. E. Hubb.	2.75	0.37	0.50
S. verticillata (L.) Beauv.	2.15	0.57	0.67
S. viridis (L.) Beauv.	2.38	0.25	0.25
Spinifex hirsutus Labill.	10.29	0.25	1.00
Stenotaphrum secundatum (Walt.) Kuntze	4.60	0.39	0.42
Trichachne californica (Benth.) Chase	2.33	0.16	0.33

no structure that could be clearly called a germination lid; *Anthephora hermaphrodita* (L.) Kuntze on the other hand had a clearly defined lid. On the basis of the presence of a germination lid in the latter species, we would retain *Anthephora* in the Paniceae, a placement advocated by Stebbins and Crampton (1961). *Melinis minutiflora* Beauv. does not have a germination lid and should, in our opinion, be once again segregated in the Melinideae of Hitchcock (1951).

Olyra has been variously placed. Hitchcock (1951) considered *Olyra* to be in the Paniceae, while Stebbins and Crampton (1961) placed it in the Oryzoideae, tribe Olyreae. Reeder (1962) examined embryo characters and placed *Olyra* in the Bambusoideae. We examined *O. latifolia* L. and observed a large distinct germination lid almost 1 mm square and visible to the naked eye. This observation supports the placement of this genus in the Paniceae of Hitchcock (1951).

Twenty-five species of Andropogoneae from 16 genera and one species of Melinideae were examined (e.g., *Andropogon ternarius* Vasey, fig. 7); none of these Panicoid species has a germination lid. The five remaining subfamilies of the Gramineae were also examined; of 27 tribes and 30 genera none was observed to have a germination lid. The germination lid is, therefore, a feature found in the florets of the Paniceae. This character is suggested as an additional feature useful to determine generic relationships in the grasses.

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Two New Plants for Nevada.—*Camissonia cardiophylla* (Torr.) Raven subsp. *robusta* (Raven) Raven is now known from four stations in Clark County, Nevada: Black Hills, crevices in volcanic ridge near crest of mountain (Northwest Boulder City, SE¼ S16 T23S R63E), 1187 m, 12 Dec 1967, *V. Bostick 3225* (Univ. Nevada, Las Vegas); south end of Black Hills, steep rocky slopes (Northwest Boulder City, SE¼ S31 and SW¼ S32, T24S R62E), 1000 m, 11 Nov 1970, *V. Bostick 5253* (Univ. Nevada, Las Vegas); crevices in basalt cliff, southern exposure (Northwest Sloan, SE¼ S21 T24S R63E), 1187 m, 15 Feb 1971, *V. Bostick 5305* (MO). The range of this plant is hereby extended 129 km east from the Death Valley region, where this subspecies is found in washes at the base of the Panamint, Funeral, Grapevine, and Argus Mountains.

Asplenium resiliens Kunze is now known from one station in Nevada: southeastern Spring Mountain Range, south fork Pine Creek, north-facing cliff of Navajo sandstone, 1450 m, 16 Jun 1970, *J. C. Fisher, Jr., and G. R. Kennedy s.n.* (Univ. Nevada, Las Vegas). The range is here extended by 324 km to the west, the nearest location being the mountains about Flagstaff, Arizona. The entire range extends from southern Pennsylvania to Jamaica and Mexico, west through Illinois and Oklahoma to New Mexico and Arizona. It is notable that Pine Creek supports a relictual Pleistocene plant community in southern Nevada.—Jack C. Fisher, Jr., Biology Department, University of California, Riverside 92502.